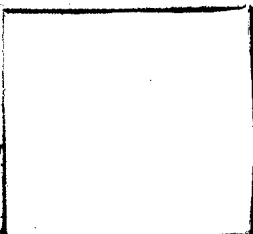


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23 March 1960

CHINESE STUDIES ON PRECIPITATION

DURING THE PAST DECADE

- COMMUNIST CHINA -

By Hsieh I-ping

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CHINESE STUDIES ON PRECIPITATION
DURING THE PAST DECADE

[This is a translation of an article written by HSIEN I-ping, Peking University, in Ch'i-hsiang Hsueh-pao (Journal of Meteorology), Peiping, Vol XXX, No 3, pages 223-235.]

Precipitation is one of the weather elements closely related to national economy. The distribution of precipitation varies greatly with time and region. The demand for data on precipitation also varies according to the individual function of various capital construction and production departments. The duration of precipitation may be long or short, and the [area of the] region--large or small.

Since liberation, Chinese meteorological workers have done a great deal of work on precipitation and have also attained tremendous achievements. As a result, the demands of capital construction and production departments have been satisfied to a certain degree. At the same time, the achievements have also enabled us to obtain a better understanding of the processes and phenomena of precipitation than we had ten years ago. Moreover, our precipitation forecasts are more reliable than before.

Our research work on precipitation during the past decade may be divided into the following types:

The first type of work was designed to satisfy the requirements of short-range forecasts. It dealt with research work on precipitation from the standpoint and according to the methods, of pure climatology. It emphasized relations between the regional distribution of precipitation and the weather systems, and between precipitation and cold air movements.

Chinese workers have accumulated several thousand years of experience. This fact was emphasized and discussed more

than twenty years ago by CHU K'o-chen^{1/} from the standpoint of modern meteorology, and on the basis of the scanty records then available.

After liberation, the national economy entered into its period of recovery, and the meteorological workers of China made use of the ever-increasing records and data of surface observations and wind measurements in the upper air as a basis to ascertain the relationship between precipitation and cold air movements. Many articles were published on this subject.

The studies of CHEN Han-yao and LIAO Tung-hsien^{2/} on the classification of thunderstorms, of LI Ming-hsi, MOU Wei-feng, and CHAO Kuo-tsang^{3/} on the types of currents in the upper air and the precipitation in central and south China, and of YANG Chien-ch'u^{4/} on the positions and directions of movement of the centers of precipitation and their relation to troughs in the upper air are representative works of this period.

Chen and Liao pointed out that thunderstorms connected with the cold front and cold turbulence were the most numerous in frequency and the greatest in intensity. The conclusions of Li, Mou and Chao on cold fronts, static fronts, frontal lows, turbulence in the upper air, and the formula expressing the change in the weather systems associated with summer precipitation were outstanding achievements, considering the amount of meteorological records available at the time.

The fact that the center of precipitation is located in the eastern part of the upper air trough and that it also shifts with the currents in the upper air--as has been pointed out by YANG Chien-ch'u--not only reveals the three-dimensional structure of rainy weather but also expounds the problems concerning the movement and development [of the centers of precipitation].

During this period, the problem of the gloomy rainy season--known as the "mei-yu" [or plum rains in the lower Yangtze valley]--which has long been a subject of discussion in China was further studied ^{5/}_{6/}^{7/} by the meteorological workers of China; thus we are able to understand more accurately the relation between the plum rains and the weather systems, as well as the time intervals relating to the distribution of precipitation conditions during the plum rain season.

The tremendous effects on precipitation in China due to the interaction between troughs and the low latitude systems, such as the easterly waves and the mid-latitude westerlies, also began to elicit more attention ^{8/} during the past decade.

Precipitation of a calamitous nature in China was under discussion in 1955, ^{9/} and various surface maps, wind observations, and a small number of records relating to the probing of the upper atmosphere were summarized. On this basis efforts were made to analyze data and experience connected with forecasting precipitation. In this way, the work of the past few years was accumulated and fused into a unified subject.

Since 1955, additional detailed three-dimensional analyses have been made possible because of the increase in data on upper air probes. HSIEH I-ping and associates ^{10/} discussed the five weather systems which had caused precipitation in the summer half of the year, as well as the three-dimensional structure of, and the process of change in, the warm pressure fields of these systems, namely, the cold fronts, warm fronts, the obstructed highs and the truncated lows, the monsoonal lows and the equatorial fronts and typhoons. These [analyses] marked the beginning of this type of work.

Subsequently, the work of HSU Ta-sheng and associates ^{11/ 12/} clarified concepts concerning the process and three-dimensional structure of weather conditions associated with precipitation due to the return flow [of air currents] in north China, where such weather conditions have long been under observation. The study of the distribution of precipitation and the structure of typhoons by LIU K'uang-nan and TUNG K'o-ch'in ^{12/} involved considerable detailed work on those typhoons which had reached land.

Since the summer of 1958, research work on short-range processes and the rainy weather systems has not only involved more comprehensive problems but also has approached the analytic stage. This type of work, which is still in progress, has been performed by work teams under the direction of T'AO Shih-yen, CHANG Yen and CHEN Wen-ch'i ^{14/ 15/}, T'AO Shih-yen and KUEI P'ei-lan ^{16/}, and CHANG Yu-ling, CHEN Ch'iu-shih and CHANG Hsun ^{17/}.

The second type of work was designed to fulfill the mission of medium and long-range forecasting, and was based on studies

on precipitation from the standpoints of medium and long-range weather processes and atmospheric circulation. The study on summer floods and droughts in China by T'U Ch'ang-wang and NIU T'ien-jen ^{18/} emphasizes the fact that excellent results may still be obtained, despite incomplete weather records.

The Associated Center ^{19/} once undertook to forecast summer precipitation in China according to the Soviet concept of the natural periodicity of weather, and thus set an example of work which reflected the result of practising the techniques of the Soviet Union.

Research studies on medium-range processes and factors controlling rainy weather during the Chinese mid-summer by HSIEH I-ping and TS'ENG Ch'ing-ts'un ^{20/}, on the rather long-range processes of atmospheric circulation during the plum rain season by T'AO Shih-yen, CHAO Yu-chia and CHEN Hsiao-min, ^{21/} and on the formation and development of typhoons based on the study of equatorial weather maps by CHEN Hsi-chang ^{22/} have embraced definitely creative ideas.

Research on the practice of forecasting on the basis of seasonal changes in atmospheric circulation includes a forecast of the onset of the rainy season in Yunnan by LI Hsuan-chou, ^{23/} and medium and long-range forecasts of precipitation during the rainy season in the upper and middle reaches of the Yangtze River by work teams under the direction of HSIEH I-ping, WANG Yao-sheng, CHEN Shou-chun and TAI Wu-chieh. ^{24/}, ^{25/}

The medium and long-range forecasts of precipitation during the rainy season in the upper and middle reaches of the Yangtze River were formulated on the basis of the constancy of the yearly indices indicating the shift of the westerlies southward or northward, as well as on the basis of the regularity with which atmospheric conditions in key areas vary and the regularity governing the inter-relationship and mutual control between the small, medium and large weather systems, on the one hand, and the short, medium and long-range weather processes on the other. These forecasts, which are still in progress, represent a rather comprehensive work relating to the processes of change in atmospheric circulation and their application in weather forecasting.

The third type of work pertained to weather, climatology, and statistical methods; it aimed at satisfying the requirements of long-range forecasting. The studies by LU Ch'iung ^{26/} on the problems of flood and drought, as related to the temperature of sea water, were based on a study of historical records of water temperature in the seas and oceans and its relation to floods and droughts in China. Such studies represent an attempt to study the long-range weather processes from the standpoint of oceanography and meteorology. It is to be regretted that very little work has been done along this line.

The studies of YANG Chine-ch'u ^{27/} on long-range weather processes employing statistical methods, from the standpoint of climatology, were excellent achievements despite insufficient data. His methods, which have been widely adopted by forecasters in meteorological stations and observatories throughout the nation and which have since been expanded and improved by incorporating local conditions and problems, have exerted a positive influence on the construction of the national economy during the past eight years.

The objective method of forecasting precipitation, as formulated by CHANG Yen and TAI Wu-chieh, ^{28/} represents a new approach to the study of weather science whereby short-range forecasts on precipitation may be formulated through statistical methods. This method, which has been adopted and improved by meteorological stations and observatories in various localities, has also produced significant effects on production.

The work of CHU Ping-hai ^{29/} on the intensity of precipitation and that of KAO Yu-hsi and KUO Ch'i-yun ^{30/} on autumnal precipitation are good reference materials for studies of precipitation.

The fourth type of work was related to the study, by diversified approaches, on the problems concerning the possibility of maximum precipitation. The computations by YEH Tu-cheng and HSU Shu-ying ^{31/} revealed that the maximum intensity of precipitation in north China might surpass 50 millimeters in five minutes. These [computations] might serve as valuable reference materials for those engaged in the management of reservoirs and the conservation of soil and water.

The work team ^{32/} under the direction of HSIIEH I-ping, T'ANG Chih-yu, and WANG Tso-shu made a study of maximum precipitation within 60 days in the areas of the upper reaches of the Yangtze River from the standpoint of medium and long-range weather processes. Their findings have definitely exerted a significant influence on the construction of the national economy.

Furthermore, an attempt was made to study the causes of precipitation on the basis of the circulation of water vapor; but relatively little work was done along this line. HSU Shu-ying ^{33/} computed the monthly mean precipitation. HSIIEH I-ping and TAI Wu-chieh ^{34/}, by computations derived from three examples, pointed out the fact that transportation is very active in the lower layer of water vapor and that the continents are an important source of water vapor.

In addition, a study on the characteristics of the distribution of annual precipitation was made on the basis of mathematical and statistical theories, such as the work of HSU Erh-hao ^{35/}, which is very useful in dealing with the distribution of precipitation on the basis of quantity. Forecasting work based on the amount of precipitation has already begun.^{36/}

From the standpoint of science, problems connected with precipitation are extremely complex; their solutions involve a number of factors, such as the evaporation of water on the surface of the oceans and the continents, the rapid flow and the vertical and horizontal movements in convection and convergence, and the various processes involved in the condensation and fall of water vapor.

During the past ten years, the meteorological workers of China have done a great deal of work and have printed or mimeographed more than one hundred essays on the subject. Their work has definitely satisfied some of the preliminary requirements of the construction of the national economy. Nevertheless, final solutions to these problems are still remote. Therefore, efforts must be organized and coordinated according to an over-all plan, and the division of labor must be so executed that the solutions of these important problems may soon be at hand.

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